

Main Street (Route 9)/ Pleasant St (Route 31)

Spencer,
Massachusetts

Prepared for **Massachusetts Department of Transportation-
Highway Division**

Prepared by **Vanasse Hangen Brustlin, Inc.
Worcester, Massachusetts**

- Submittal Letter
- Preliminary Cost Estimate
- MassDOT 25% Design Checklist
- Pavement Design and Checklist
- Horizontal Alignment Reports

25% SUBMISSION
November 22, 2013

Submittal Letter



November 22, 2013

Vanasse Hangen Brustlin, Inc.

Ref: 11537.00

Marie Rose, P.E.
Director of Project Management
Massachusetts Department of Transportation
Highway Division
Ten Park Plaza, Room 6340
Boston, MA 02116

Attn.: Thomas Currier, Project Manager

Re: Transportation Improvement Project
Main Street (Route 9), Spencer
Project File #606207
25% Design Submission

Dear Ms. Rose:

On behalf of the Town of Spencer, Vanasse Hangen Brustlin, Inc. (VHB) is pleased to submit the 25% Design Documents for the above referenced project. These documents have been provided for your review and comments. The 25% submittal includes the following documents:

- Eleven (11) sets of the 25% Design Plans (10 full size sets, one ½ size set for FHWA review)
- One (1) full size, colored, partial set of 25% Design Plans for MassDOT Utility Engineer's use
- Two (2) full size sets of the Preliminary Right-of-Way Plans
- Two (2) copies of the 25% Design Submission Booklet (1 copy for FHWA review)
which contains:
 - Submittal Letter
 - Construction Cost Estimate
 - 25% Highway Design Checklist
 - Pavement Design & Checklist
 - Horizontal Alignment Reports
- Three (3) copies of the Functional Design Report (1 copy for FHWA review)
- One (1) copy of the Design Exception Report
- One (1) CD containing electronic data of all submission documents listed above

Union Station, Suite 219
2 Washington Square
Worcester, Massachusetts 01604
508.752.1001 • FAX 508.752.1276
email: info@vhb.com
www.vhb.com

- Eight (8) CD's containing electronic drawings for submission to affected utility companies (National Grid/Verizon/Charter Communications/Town, etc.)

VHB will also submit one set of 25% Design Plans, one set of Preliminary Right-of-Way Plans and one copy of the 25% Booklet to the Town of Spencer for their review and comments.

Please note that the 25% Early Environmental Coordination Checklist (EECC), with supporting documents, was prepared by the Town of Spencer and previously submitted to your office by the Town's Utilities and Facilities Director.

For the purposes of this submission, a field meeting was conducted with National Grid during the 25% design phase of the project. As a result of this meeting, the plans include utility pole relocations that have been tentatively agreed upon. However, we do realize that a field meeting with all affected utility companies will be conducted by the District 3 Utility and Construction Engineer (DUCE) at some point in the near future. This preliminary meeting was held in order to verify that the relocations were deemed reasonable so that an estimate of the required relocation costs could be prepared and included in the 25% Construction Cost Estimate. The amount of reimbursable utility costs was estimated using values provided by the DUCE, with 50% of the costs included in the estimate, per current MassDOT policies.

Because this section of Main Street has NHS designation, it was determined that the required shoulder width could not be attained, thus a Design Exception Request (DER) would need to be prepared. Based on this issue, a field meeting was also conducted with the Department's Complete Streets Engineer (CSE) during the 25% design phase to determine what design elements would be acceptable to address bicycle accommodations in the downtown area. As a result of this meeting, and subsequent guidance from the CSE, design elements have been provided as part of the 25% Submission with the understanding that they would meet Department approval.

It is also important to note that the Town of Spencer is currently coordinating with the owners (S-BNK Spencer, LLC.) of the property on the northwest corner of Main Street and Pleasant Street regarding the actual work that is necessary on the site as a result of the Pleasant Street realignment. Until an agreement can be reached, limited on-site work is proposed on this property at this time. The estimate does include a contingency cost for the anticipated work required. Additional design elements and details will be provided as part of the 75% Design Documents, once negotiations have been finalized.

If you should have any questions or require additional information, please do not hesitate to contact this office. We are available to meet, if required, to discuss the project at your earliest convenience.



Very truly yours,


VANASSE HANGEN BRUSTLIN, INC.

Brian Brosnan, P.E.
Project Manager

Attachments

xc: Steven Tyler – Spencer Utilities and Facilities Director (w/attachments)
Jonathan Gulliver – MassDOT District 3 Highway Director
File



Preliminary Cost Estimate



25% Cost Estimate - Participating Costs
Main Street
Spencer, Massachusetts

<u>Description</u>	<u>Unit Price</u>	<u>Quantity</u>	<u>Total Cost</u>
Full Depth Pavement	\$95.00 /SY	1,600 SY	\$152,000.00
Full Depth Pavement Less than 4' Wide	\$110.00 /SY	260 SY	\$28,600.00
Pavement Milling & Overlay	\$45.00 /SY	6,800 SY	\$306,000.00
Pavement Milling & Overlay - Side Streets	\$30.00 /SY	700 SY	\$21,000.00
Hot Mix Asphalt Pavement for Patching	\$80,000.00 /LS	1 LS	\$80,000.00
Cement Concrete Walk	\$80.00 /SY	2,250 SY	\$180,000.00
Cement Concrete Wheelchair Ramps	\$100.00 /SY	350 SY	\$35,000.00
Cement Concrete Drive	\$85.00 /SY	425 SY	\$36,125.00
Hot Mix Asphalt Drive	\$55.00 /SY	625 SY	\$34,375.00
Hot Mix Asphalt Walk	\$45.00 /SY	15 SY	\$675.00
Loam & Seed	\$10.00 /SY	950 SY	\$9,500.00
Wood Chip Mulch	\$5.00 /SY	200 SY	\$1,000.00
Removal of Exist Full Depth Pavement	\$35.00 /SY	900 SY	\$31,500.00
Sawing Asphalt Pavement	\$2.00 /FT	4,400 FT	\$8,800.00
Vertical Granite Curb - Type VA4	\$50.00 /FT	3,750 FT	\$187,500.00
Vertical Granite Curb - Type VB	\$45.00 /FT	250 FT	\$11,250.00
Granite Curb Corner - Type A	\$250.00 /EA	35 EA	\$8,750.00
Vertical Granite Curb Removed & Stacked	\$35.00 /FT	3,050 FT	\$106,750.00
Granite Curb Corner Removed & Stacked	\$78.00 /EA	35 EA	\$2,730.00
Drainage Modifications	\$105,000.00 /LS	1 LS	\$105,000.00
Water System Modifications	\$20,500.00 /LS	1 LS	\$20,500.00
Signing & P'vmt Markings	\$34,000.00 /LS	1 LS	\$34,000.00
Stone Masonry Retaining Wall	\$700.00 /FT	230 FT	\$161,000.00
6' Chain Link Fence Vinyl coated	\$30.00 /FT	230 FT	\$6,900.00
R&R Historic Stone Masonry Ret Wall	\$1,000.00 /FT	30 FT	\$30,000.00
Landscaping & Street Furniture	\$80,000.00 /LS	1 LS	\$80,000.00
Street Lighting, foundations, conduit, etc.	\$250,000.00 /LS	1 LS	\$250,000.00
Traffic Signals	\$310,000.00 /LS	1 LS	\$310,000.00
Decorative CrossWalk Surface	\$200.00 /SY	320 SY	\$64,000.00
Utility Pole Relocation Costs (50% of total)	\$100,000.00 /LS	1 LS	\$100,000.00
Contingency for Sitework at S-BNK Property	\$130,000.00 /LS	1 LS	\$130,000.00
SUBTOTAL:			\$2,532,955.00
Construction Traffic Management (3%)			\$75,988.65
Mobilization (3%)			\$75,988.65
Contingency (10%)			\$253,295.50
Traffic/Police (7%)			\$177,306.85
Construction Engineering (10%)			\$253,295.50



25% Cost Estimate - Participating Costs
Main Street
Spencer, Massachusetts

TOTAL:	\$3,368,830.15
Inflation (3% - 3 years)	\$312,381.51
	\$3,681,211.66
SAY:	\$3,700,000

This estimate does not consider any Right of Way acquisitions

MassDOT 25% Design Checklist

PURPOSE

The 25% highway design review is intended to provide MassDOT's Highway Division the opportunity to evaluate the proposed design relative to current design standards, right of way impacts, environmental impacts and other potential community concerns associated with the proposed design.

GENERAL

This checklist represents the minimum amount of issues that should be considered when reviewing a 25% highway submittal. The information below is not intended to address all aspects of plan preparation. To the extent practical, any comments relative to plan preparation made at the 25% stage will certainly improve the quality of the 75% submittal.

Any question listed below with a No (N) or Not Applicable (NA) answer requires a written comment.

PLANS

- | | Y | N | NA | |
|------|--|--------------------------|-------------------------------------|---|
| | | | | 0.00 Drawing Files |
| 0.01 | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | For projects initiated after January 1, 2012, have the plans been prepared according to and in conformance with the MassDOT Highway Division CAD Standards? |
| | Comment: _____ | | | |
| | | | | 1.00 Title Sheet |
| 1.01 | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | For projects initiated prior to January 1, 2012, is the Title Sheet prepared consistent with Exhibit 18-14? |
| | Comment: Project initiated after January 1, 2012. | | | |
| 1.02 | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Is the DESIGN DESIGNATION table completed? |
| | Comment: _____ | | | |
| 1.03 | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Does the Design Speed correlate with Exhibit 3-7, or the design speed identified in the Design Exception Report, if applicable? |
| | Comment: _____ | | | |
| 1.04 | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Are the stations and coordinates for the beginning and end of project shown on the locus map? |
| | Comment: _____ | | | |
| 1.05 | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | Are bridge numbers shown on the locus map? |
| | Comment: No bridges located within the project area. | | | |

	Y	N	NA	
2.00 Typical Sections				
2.01	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Do the proposed lane and shoulder widths shown on the typical sections properly account for the offset dimension?
	Comment: _____			
2.02	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Are the proposed lane and shoulder widths consistent with Section 5.3.3, or the Design Exception Report, if applicable?
	Comment: _____			
2.03	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Is the method of banking adequately represented on the Typical Sections in manner consistent with Section 4.2.5?
	Comment: <u>The proposed cross-sections match existing cross-slopes.</u>			
2.04	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Is the location of the PGL the most appropriate location for the proposed project?
	Comment: _____			
2.05	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Does the shoulder break away from travel lanes when the width is greater than 4 feet?
	Comment: <u>A 5 foot shoulder for bike accommodation is proposed wherever possible, and the proposed shoulder utilizes the same cross-slope as the travel lanes due to existing building entry constraints.</u>			
2.06	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Is the proposed pavement structure appropriate (full depth, reclamation, overlay)?
	Comment: _____			
2.07	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Are the pavement structure materials labeled consistent with the latest STANDARD NOMENCLATURE AND LIST OF STANDARD ITEMS?
	Comment: _____			
2.08	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Is the proposed wearing surface compatible with the function of the proposed roadway?
	Comment: _____			
2.09	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	If a narrow (less than 4 feet) box widening is proposed, was Cement Concrete Base Course considered in lieu of full depth pavement?
	Comment: _____			
2.10	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Are the guardrail details consistent with the CONSTRUCTION AND TRAFFIC STANDARD DETAILS?
	Comment: <u>Guardrail is not proposed as part of this project.</u>			
2.11	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Section 5.3 provided general guidance on a variety of cross section elements for each area type. Are the proposed Typical Sections consistent with these figures relative to dimensions, slopes and materials?
	Comment: _____			
2.12	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	If retaining walls are proposed, does the design allow for guardrail to be adequately installed? Guardrail located on top of an existing or proposed stone masonry wall generally requires a moment slab.
	Comment: _____			
3.00 Construction Drawings				
3.01	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Is the existing Base Plan information plotted consistent with Section 18.2.1.2?
	Comment: _____			
3.02	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Is the proposed horizontal geometry adequately described? (PC, PT, R, T, DELTA, L)?
	Comment: _____			
3.03	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Is the minimum radius consistent with Exhibits 4-8 & 4-9 based on the Design Speed noted on the Title Sheet?
	Comment: <u>A design exception is being requested for the horizontal alignment.</u>			
3.04	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	If compound curves are employed, are they designed in accordance with Section 4.2.1.3?
	Comment: _____			

	Y	N	NA	
3.00 Construction Drawings (Cont.)				
3.05	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Are there any features which negatively impact horizontal sight distance as described in Section 4.2.2?
Comment: _____				
3.06	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Are cross culverts and drainage outlet locations shown on the plans?
Comment: _____				
3.07	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Are approximate slope limits shown?
Comment: _____				
3.08	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Based on the cross-sections provided and other available information are the proposed guardrail locations appropriate?
Comment: <u>Guardrail is not proposed as part of this project.</u>				
3.09	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Have the impacts to existing wetlands and other resource areas been minimized?
Comment: <u>There are no wetlands located within the project area.</u>				
3.10	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Does the proposed design reasonably accommodate vehicle turning movements based on the turning paths transparencies included in Chapter 6?
Comment: _____				
3.11	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	If applicable, are storage and deceleration lengths consistent with Section 6.7.3?
Comment: _____				
3.12	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Is the proposed design consistent with ADA and AAB requirements?
Comment: _____				
3.13	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Are stations at the beginning and end of project noted?
Comment: _____				
3.14	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Is the existing layout information accurately depicted?
Comment: _____				
3.15	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Are the approximate limits of proposed takings and easements shown?
Comment: _____				
3.16	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Is sufficient right of way available to perform the work?
Comment: _____				
3.17	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Are all the walks, sidewalks, crosswalks, and curb cut wheelchair ramps meet the requirements listed in Americans with Disabilities Act Accessibility Guidelines (ADAAG) and Public Rights of Way Accessibility Guidelines (PROWAG), which are discussed in the Engineering Directive E12-005)?
Comment: <u>A section of the roadway has a gradient of 11.8% and accessibility requirements can not be met.</u>				
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	If not, have all violations been identified and clearly discussed for MassDOT's review?
Comment: <u>The area has been identified and preliminarily discussed with the District.</u>				
4.00 Profiles				
4.01	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Is the existing base profile information plotted consistent with Section 18.2.1.3? (station equations, cross culverts, bridge structures, sills of structures, high tension lines, bench marks, etc.)
Comment: _____				
4.02	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Are the proposed profiles prepared consistent with Exhibit 18-11?
Comment: _____				
4.03	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Are all aspects of the vertical geometry noted (Stopping Sight Distance, Passing Sight Distance (if applicable), G1, G2, L, K, station and elevation of the PVC, PVT and PVI)?
Comment: _____				

Y N NA 4.00 Profiles (Cont.)
 4.04 ☐ ☒ ☐ Is the stopping sight distance consistent with the Design Speed noted on the Title Sheet and Exhibit 3-8?

Comment: A design exception is being requested for the vertical alignment.

4.05 ☐ ☒ ☐ Is the K value consistent with the Design Speed noted on the Title Sheet and Exhibit 4-26 or 4-27?

Comment: A design exception is being requested for the vertical alignment.

4.06 ☐ ☒ ☐ Is the maximum grade consistent with the Design Speed noted on the Title Sheet and Exhibit 4-21?

Comment: A design exception is being requested for the vertical alignment.

4.07 ☐ ☒ ☐ Is the minimum grade consistent with Section 4.3.1? If a closed drainage system is proposed it is recommended that a minimum grade of 0.6% be used.

Comment: A design exception is being requested for the vertical alignment.

Y N NA 5.00 Traffic Signal Plans
 5.01 ☒ ☐ ☐ Are signal heads located in the vision cone specified by the MUTCD?

Comment: _____

5.02 ☒ ☐ ☐ Are pavement markings clearly displayed and labeled?

Comment: _____

5.03 ☒ ☐ ☐ Does the Phasing Diagram adequately address pedestrian volumes? (pedestrian phases concurrent or actuated)

Comment: _____

5.04 ☒ ☐ ☐ If appropriate does the Phasing Diagram address emergency preemption?

Comment: _____

Y N NA 6.00 Traffic Management Plans (may be 8-1/2 x 11 for simple projects)
 6.01 ☒ ☐ ☐ Does the TMP provide sufficient information to determine that the proposed project can be constructed without undue inconvenience to the public?

Comment: _____

6.02 ☐ ☐ ☒ For projects with a detour, is the proposed detour reasonable considering available traffic data?

Comment: A detour is not proposed for this project.

6.03 ☒ ☐ ☐ Does the proposed TMP adequately address bicycle and pedestrian accommodation?

Comment: _____

7.00 Cross Sections (Although only top line sections in critical areas are required according to the PDDG, the latest engineering software makes providing all cross sections a simple matter. The top line information is intended to depict the relationship between the proposed roadway and the existing features only. However to the extent that additional information is provided, it is worthwhile to comment relative to consistency with Section 18.2.2.5.)

Y N NA
 7.01 ☒ ☐ ☐ Is the existing cross-section information plotted consistent with Section 18.2.1.4 and Exhibit 18-5? Are walls, hydrants, poles, trees over 8 inches, sills, wells, septic systems, cross culverts, ledge, layout lines, etc. plotted on the cross-sections?

Comment: _____

- Y N NA 7.00 Cross Sections (Cont.)
- 7.02 ☐ ☐ ☒ Does the proposed cross-section provide sufficient area to install guardrail where necessary?
Comment: Guardrail is not proposed as part of this project.
- 7.03 ☒ ☐ ☐ Have the proposed side and back slopes been appropriately chosen to balance impacts with safety and slope stability?
Comment: _____

SPECIAL CONSIDERATIONS

- Y N NA 8.00 Projects that include bridge(s)
- 8.01 ☐ ☐ ☒ Is the project subject to the Highway Division's Non-NHS Bridge R&R Policy? (According to Engineering Directive P-92-010 in order for these guidelines to apply the roadway must be classified as either a Minor Arterial, Urban Extension of a Minor Arterial, Collector or Local roadway)
Comment: No bridge in this project.
- 8.02 ☐ ☐ ☒ If the project is subject to P-92-010 is the proposed bridge width and approach geometry consistent with the Engineering Directive?
Comment: No bridge in this project.
- 8.03 ☐ ☐ ☒ For bridge projects that are not subject to P-92-010 are the proposed bridge dimensions and vertical clearance consistent with Section 4.3.4 and Exhibit 4-28?
Comment: No bridge in this project.
- 8.04 ☐ ☐ ☒ Do the construction drawings adequately depict the existing bridge structure including subsurface features?
Comment: No bridge in this project.
- 8.05 ☐ ☐ ☒ Do the construction drawings adequately depict the relationship between the existing and the proposed bridge structure?
Comment: No bridge in this project.
- 8.06 ☐ ☐ ☒ Does the TMP provide adequate dimensions such that the relationship between the lane configurations and the beam spacing of both the existing and the proposed structure can be evaluated?
Comment: No bridge in this project.
- 8.07 ☐ ☐ ☒ Do the plans and cross-sections indicate that sufficient space is available to install approach guardrail?
Comment: No bridge in this project.

9.00 Freeways

The review of Freeway designs, particularly those involving grade separated interchanges does not lend itself well to a checklist type review. The design of a grade separated interchange must be evaluated based on the entire contents of Chapter 6. Listed below are some of the key items that should be reviewed.

- Y N NA
- 9.01 ☐ ☐ ☒ Is the proposed cross-section consistent with Section 5.3.4.1?
Comment: No freeway in this project.
- 9.02 ☐ ☐ ☒ Is the median barrier provided consistent Exhibit 5-33?
Comment: No freeway in this project.

- Y N NA 9.00 Freeways (Cont.)
- 9.03 ☐ ☐ ☒ Is the ramp spacing consistent with Exhibit 7-12?
 Comment: No freeway in this project.
- 9.04 ☐ ☐ ☒ Are the deceleration and acceleration lengths consistent with Exhibits 7-13 & 7-14?
 Comment: No freeway in this project.
- 9.05 ☐ ☐ ☒ Are the selected ramp design speeds consistent with Exhibit 7-15?
 Comment: No freeway in this project.
- 9.06 ☐ ☐ ☒ Does the minimum radius meet the criteria in Exhibit 7-24?
 Comment: No freeway in this project.
- 9.07 ☐ ☐ ☒ Are the ramp cross sections consistent with Section 7.7.1.2 and Exhibits 7-22 & 7-23?
 Comment: No freeway in this project.
- 9.08 ☐ ☐ ☒ Is the ramp geometry consistent with the guidelines provided in Exhibit 7-30 (a-k)?
 Comment: No freeway in this project.

- Y N NA 10.00 ESTIMATE
- 10.01 ☒ ☐ ☐ Is sufficient back up information provided to determine if the preliminary estimate is reasonable?
 Comment: _____
- 10.02 ☒ ☐ ☐ Does the estimate anticipate inflation as result of the project's proposed advertising date?
 Comment: _____
- 10.03 ☒ ☐ ☐ Does the estimate include increase for contingency, contract administration, traffic police, etc.?
 Comment: _____

11.00 FUNCTIONAL DESIGN REPORT

Refer to the Traffic & Safety Engineering Checklist.

12.00 DESIGN EXCEPTION REPORT

Refer to Chapter 2 of the Project Development and Design Guide and the Design Exception Report Checklist.

- Y N NA 13.00 CONCLUSIONS
- 13.01 ☒ ☐ ☐ Is the scope of work consistent with the scope approved by PRC?
 Comment: _____
- 13.02 ☒ ☐ ☐ Is the estimated total construction cost consistent with the STIP?
 Comment: _____
- 13.03 ☒ ☐ ☐ Does the project address known geometric and safety concerns?
 Comment: _____
- 13.04 ☒ ☐ ☐ Do the plans represent a project that is reasonable from a constructability standpoint with respect to construction techniques and available right of way?
 Comment: _____

PROJECT DESCRIPTION: 606207 - Main Street (Route 9) Spencer
25% HIGHWAY DESIGN REVIEW CHECKLIST Submission Date 11/22/2013

Y N NA 13.00 CONCLUSIONS (Cont.)

13.05 ☐ ☒ ☐ Is a letter of support and all correspondence with local historic commissions included?

Comment: A letter to the local historic commission has been sent as part of the 25% Design.

13.06 ☒ ☐ ☐ Are the plans suitable for conducting a Design Public Hearing?

Comment: _____

13.07 ☒ ☐ ☐ Has the Design Submission Distribution Chart been reviewed and has the Project Manager been contacted to ensure that each submission includes the required documentation?

Comment: _____

Designer Certification

Y

☒

The Designer certifies that the 25% Design Plans have been reviewed in accordance with this checklist and that all responses are correct and accurately reflect the information presented on the submitted Design Plans.

John J. DeLaney
Consultant Firm Principal

11/22/13
Date

Pavement Design and Checklist

Pavement Engineering Services
PHOTO LOG DOCUMENTATION
Main Street (Rte. 9) – High Street to Maple Street, Spencer, MA



The laboratory evaluation of the test pits and pavement cores revealed from 4.5" to 8.35" (average 6.75") of HMA over 5.5" to 21.5" of Poorly Graded Silty Sand (SP-SM / A-1-b) subbase and Gravel Borrow / fine Gravel Borrow (SW-SM / A-1-a) subgrade.



Pavement Engineering Services
PHOTO LOG DOCUMENTATION
Main Street (Rte. 9) – High Street to Maple Street, Spencer, MA



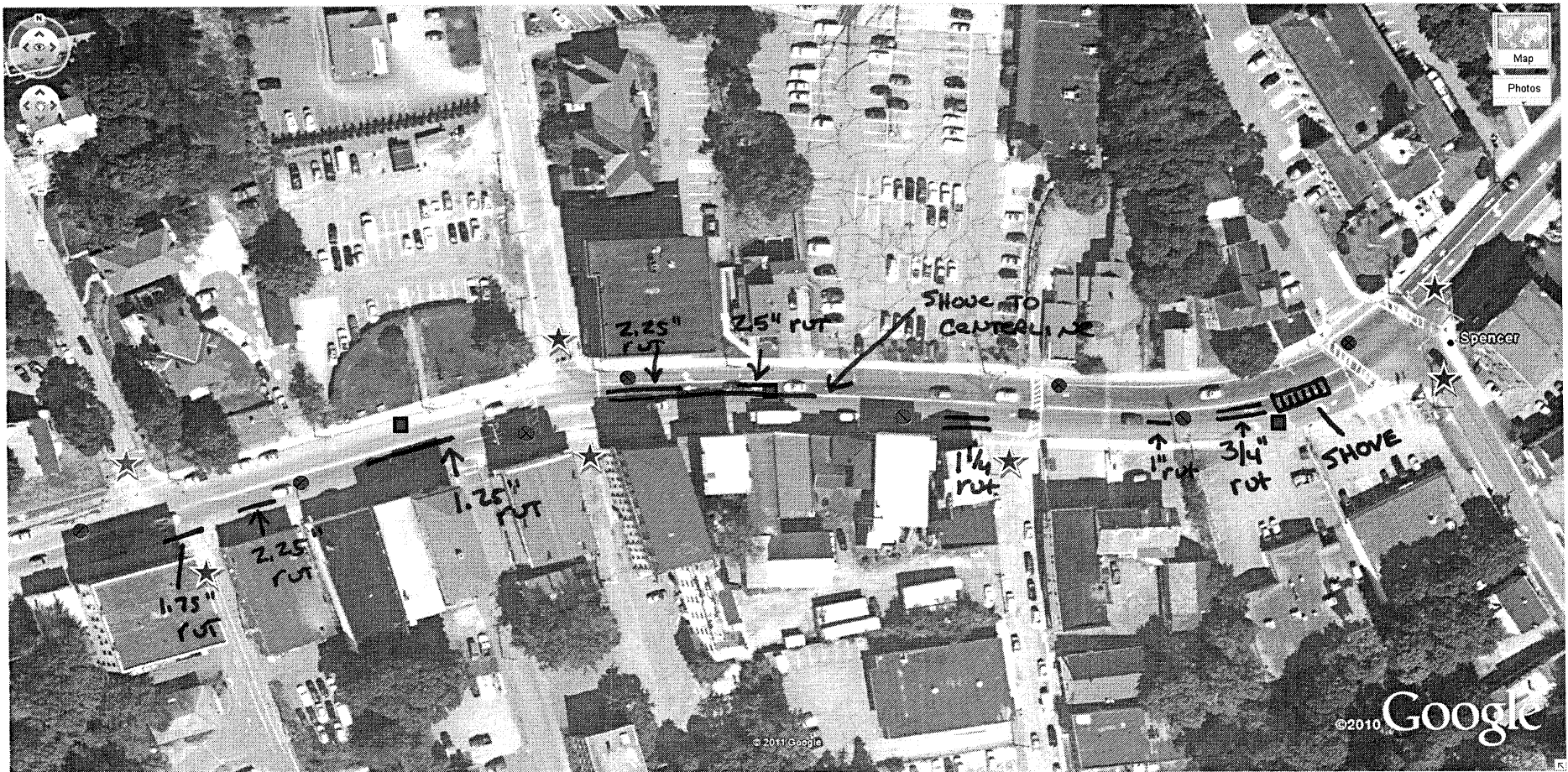
The pavement distress observations revealed extensive rutting & shoving. The shoving was most pronounced on the downhill WB approach of Main St. to Pleasant St., although was observed throughout the project limits. Surface cracking was limited to transverse & longitudinal cracks at utility trench repairs west of Pleasant Street.



RUTTING & SHOIVING DEPTH MEASUREMENTS

Route 9 – Spencer, MA

“High Street to Maple Street (Rt. 31)”



TP #1 – Approx. 115' West of Maple Street, 10' off the EB curb. // House #158 (Right Turn Lane)

TP #2 – Approx. 115' East of Pleasant Street, 17' off the WB curb. // West of Util. Pole # 98 (Center Travel Lane)

TP #3 – Approx. 65' West of Wall Street, 10' off the WB curb. // House #126 (Shoulder / Bus Loading Zone)

Pavement Engineering Services
PAVEMENT CORE PHOTO LOG DOCUMENTATION
Main Street (Rte. 9) – High Street to Maple Street, Spencer, MA



WESTBOUND
3.5' OFF CURB

EASTBOUND
15' OFF CURB

WESTBOUND
6' OFF CURB

EASTBOUND
4' OFF CURB



WESTBOUND
7' OFF CURB

EASTBOUND
13.5' OFF CURB

WESTBOUND
11' OFF CURB

EASTBOUND
6' OFF CURB


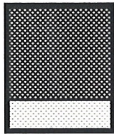

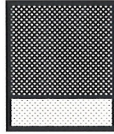
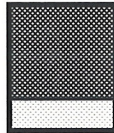


CORE PROFILE

Vanasse Hangen Brustlin, Inc.

LOCATION: Main Street, Spencer, MA
DATE SAMPLED: March 23, 2011

FROM: High Street
TO: Maple Street

<u>CORE#:</u>	<u>Area:</u>
<u>1</u>	<u>@ the municiple building, 3.5' off the WB curb.</u>
DEPTH	CLASSIFICATION
mm inches	
 173 6.9	Hot Mix Asphalt
	Sandy Gravel
<u>2</u>	<u>139' west of the municiple building, 15' off the EB curb.</u>
DEPTH	CLASSIFICATION
mm inches	
 163 6.5	Hot Mix Asphalt
	Sandy Gravel
<u>3</u>	<u>60' east of Mechanic Street, 6' off the WB curb.</u>
DEPTH	CLASSIFICATION
mm inches	
 156 6.25	Hot Mix Asphalt
	Sandy Gravel
<u>4</u>	<u>123' west of Mechanic Street, 4' off the EB curb.</u>
DEPTH	CLASSIFICATION
mm inches	
 181 7.25	Hot Mix Asphalt
	Sandy Gravel
<u>5</u>	<u>55' east of Pleasant Street, 7' off the WB curb.</u>
DEPTH	CLASSIFICATION
mm inches	
 155 6.2	Hot Mix Asphalt
	Sandy Gravel

CORE PROFILE


page 2

LOCATION: Main Street, Spencer, MA
DATE SAMPLED: March 23, 2011

FROM: High Street
TO: Maple Street


CORE#: 6

Area: 40' west of Pleasant Street, 13.5' off the EB curb.

	DEPTH		CLASSIFICATION
	mm	inches	
	209	8.35	Hot Mix Asphalt
			Sandy Gravel

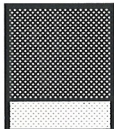
CORE#: 7

Area: 75' east of High Street, 6' off the EB curb.

	DEPTH		CLASSIFICATION
	mm	inches	
	205	8.2	Hot Mix Asphalt
			Sandy Gravel

CORE#: 8

Area: 105' west of High Street, 11' off the WB curb.

	DEPTH		CLASSIFICATION
	mm	inches	
	113	4.5	Hot Mix Asphalt
			Sandy Gravel





54 Tuttle Place
Middletown
Connecticut 06457
860 632 1500
FAX 860 632 7879

TEST REFERENCE

LOCATION: Main Street

AREA: 112' west of Maple Street, 11' off the EB curb.


DATE SAMPLED: 3/23/2011

DATE TESTED: 3/24/2011

TEST PIT # 1

DEPTH

CLASSIFICATION with Field Comments

	ENGLISH	METRIC	
	5'	127 mm	Hbt Mx Asphalt (HMA)
	14'	356 mm	Poorty Graded Silty Sand (SP-SM)
	11"	279 mm	Gravel Borrow

Test Pit # 1

Base Poorly Graded Silty Sand (SP-SM)

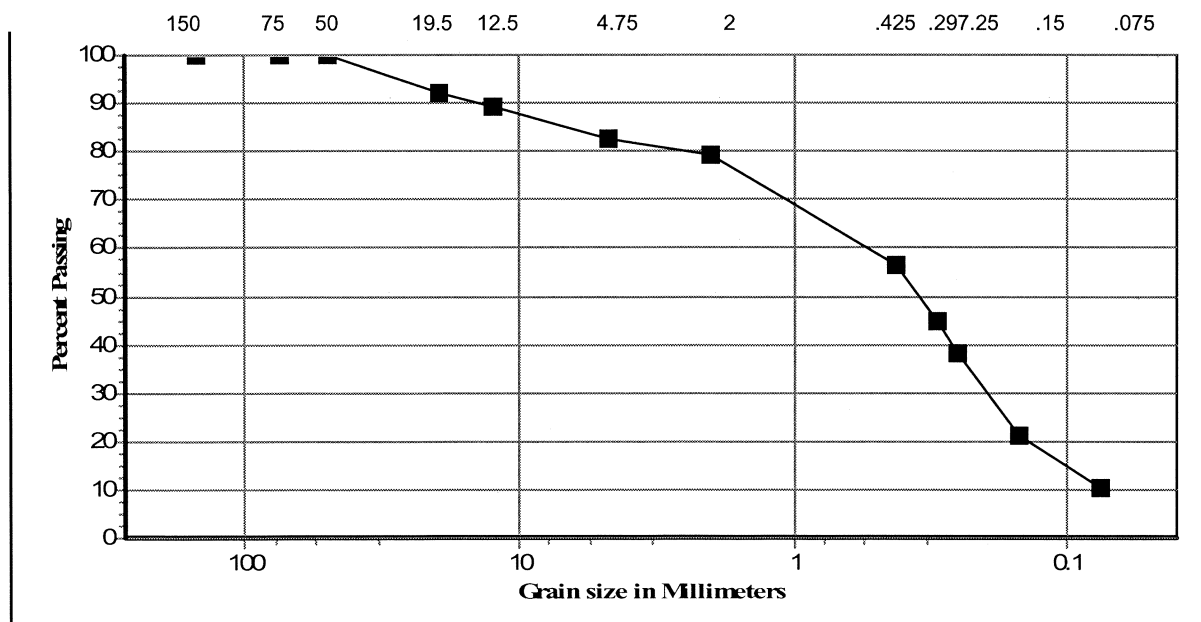
SIEVE SIZE		PERCENT PASSING	MHD Gravel M1.03 SPECIFICATION MHD
150 mm	(6)	100	100
75 mm	(3)	100	
50 mm	(2)	100	
19.5 mm	(3/4)	92	
12.5 mm	(1/2)	89 a	50-85
4.75 mm	(#4)	82 a	40-75
2 mm	(#10)	79	
0.425 mm	(#40)	57	
0.3 mm	(#50)	45 a	8-28
0.25 mm	(#60)	38	
0.15 mm	(#100)	21	
0.075 mm	(#200)	10 a	0-10

REMARKS: (a) high off specifications; does not conform to specifications

COMMENTS:

Sieve Sizes:

COBBLES	GRAVEL		SAND			CLAY or SILT
	Coarse	Fine	Coarse	Medium	Fine	
	3 1/2"	3/4"	#4	#10	#40	#200



Test Pit # 1

CLASSIFICATIONS:

UNIFIED = SP-SM

AASHTO = A-2-4

% PASSING #200 (Silt or Clay) = 10.4

% PASSING #4 (Sand) = 82.5

LIQUID LIMIT=0

PLASTICITY INDEX =0

GRAIN SIZE ANALYSIS:

D10= 0.07

D30= 0.2

Cu= 7

D60= 0.5

D85= 7

Cc= 1.0

greater than 6 & Well-Graded
between 1 & 3 Sands & Gravels

FROST POTENTIAL: moderate

DESCRIPTION: This poorly graded silty sand is a fair to good foundation when not subject to frost action, having a moderate frost potential and exhibiting fair drainage characteristics.

Test Pit # 1

SubGrade I Gravel Borrow

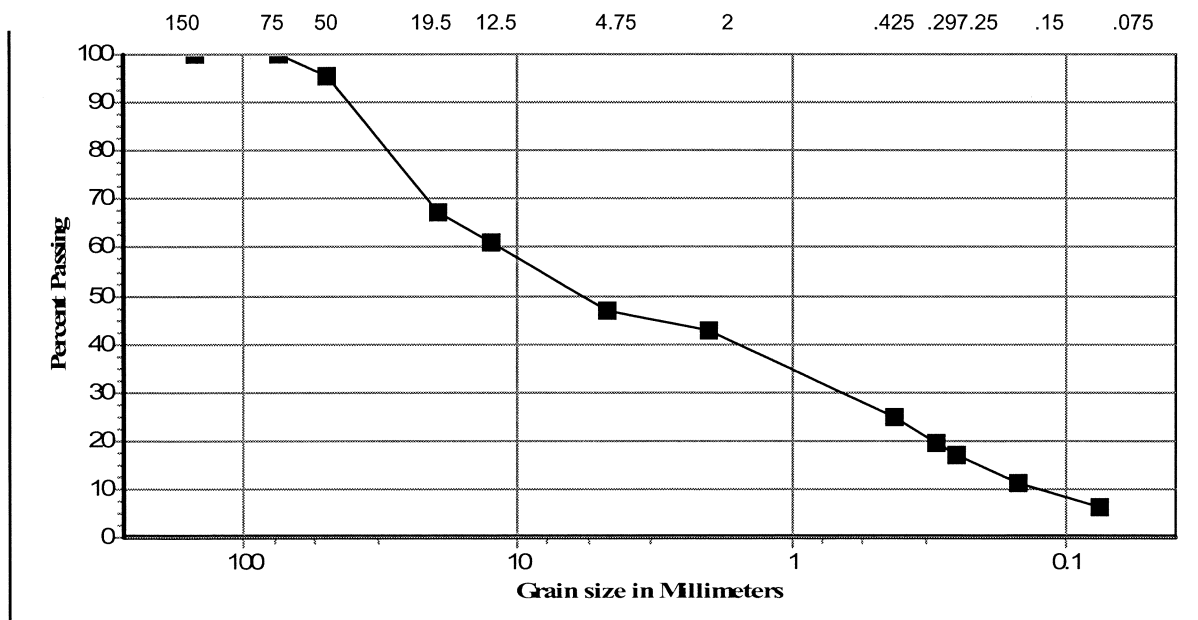
SIEVE SIZE		PERCENT PASSING	MHD Gravel M1.03 SPECIFICATION MHD
150 mm	(6)	100	100
75 mm	(3)	100	
50 mm	(2)	95	
19.5 mm	(3/4)	67	
12.5 mm	(1/2)	61	50-85
4.75 mm	(#4)	47	40-75
2 mm	(#10)	43	
0.425 mm	(#40)	25	
0.3 mm	(#50)	20	8-28
0.25 mm	(#60)	17	
0.15 mm	(#100)	11	
0.075 mm	(#200)	6	0-10

REMARKS: conforms to specifications

COMMENTS:

Sieve Sizes:

COBBLES	GRAVEL		SAND			CLAY or SILT
	Coarse	Fine	Coarse	Medium	Fine	
	3 1/2"	3/4"	#4	#10	#40	#200



Test Pit # 1

CLASSIFICATIONS:

UNIFIED = GP-GM

AASHTO = A-1-a

% PASSING #200 (Silt or Clay) = 6.1

% PASSING #4 (Sand) = 47

LIQUID LIMIT=0

PLASTICITY INDEX =0

GRAIN SIZE ANALYSIS:

D10= 0.13

D30= 0.67

Cu= 89

D60= 11.5

D85= 35

Cc= 0.3

greater than 6 & between 1 & 3	Well-Graded Sands & Gravels
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FROST POTENTIAL: slight to moderate

DESCRIPTION: This poorly graded silty gravel is a good foundation when not subject to frost action, having a slight to moderate frost potential and exhibiting fair to good drainage characteristics.



54 Tuttle Place
Middletown
Connecticut 06457
860 632 1500
FAX 860 632 7879

TEST REFERENCE

LOCATION: Main Street

DATE SAMPLED: 3/23/2011

AREA: 110' east of Pleasant Street, 12' off the WB curb.

DATE TESTED: 3/24/2011

TEST PIT # 2

DEPTH

CLASSIFICATION with Field Comments

ENGLISH

METRIC



6.5'

165 mm

Hot Mix Asphalt (HMA)

21.5'

546 mm

Silty Gravel Borrow

Test Pit # 2

Base Silty Gravel Borrow

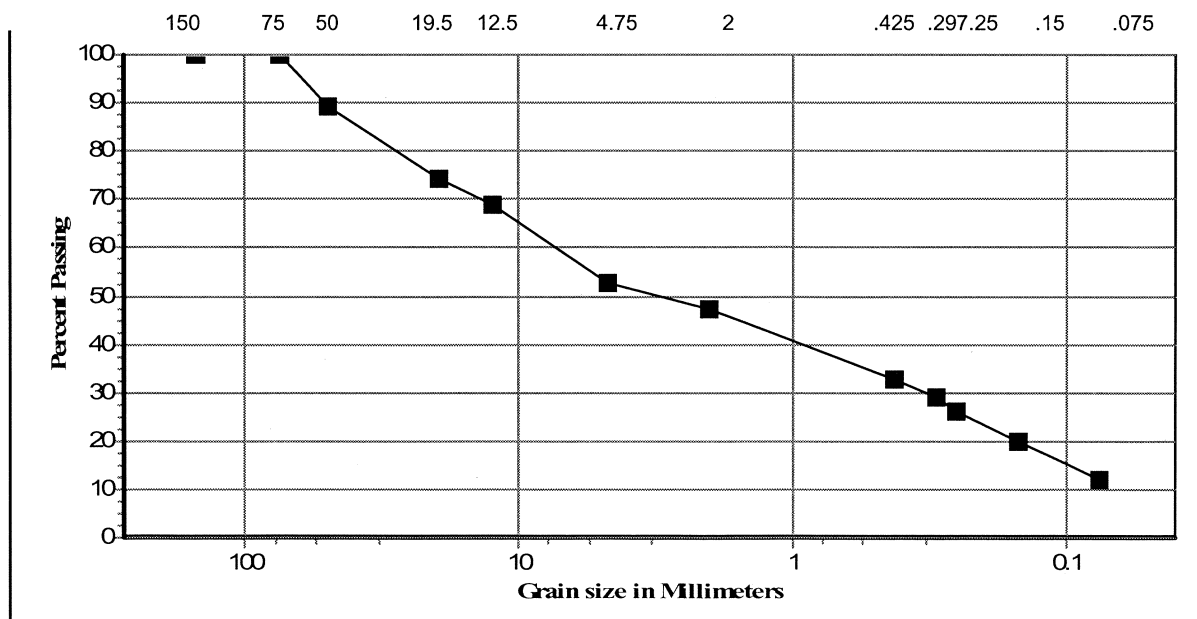
SIEVE SIZE		PERCENT PASSING	MHD Gravel M1.03 SPECIFICATION MHD
150 mm	(6)	100	100
75 mm	(3)	100	
50 mm	(2)	89	
19.5 mm	(3/4)	74	
12.5 mm	(1/2)	69	50-85
4.75 mm	(#4)	53	40-75
2 mm	(#10)	47	
0.425 mm	(#40)	33	
0.3 mm	(#50)	29 a	8-28
0.25 mm	(#60)	26	
0.15 mm	(#100)	20	
0.075 mm	(#200)	12 a	0-10

REMARKS: (a) high off specifications; does not conform to specifications

COMMENTS:

Sieve Sizes:

COBBLES	GRAVEL		SAND			CLAY or SILT
	Coarse	Fine	Coarse	Medium	Fine	
	3 1/2"	3/4"	#4	#10	#40	#200



Test Pit # 2

CLASSIFICATIONS:

UNIFIED = SP-SM

AASHTO = A-1-b

% PASSING #200 (Silt or Clay) = 12

% PASSING #4 (Sand) = 52.8

LIQUID LIMIT =

PLASTICITY INDEX =

GRAIN SIZE ANALYSIS:

D10= 0.06

D30= 0.33

Cu= 117

D60= 7.3

D85= 39

Cc= 0.2

greater than 6 & between 1 & 3	Well-Graded Sands & Gravels
-----------------------------------	--------------------------------

FROST POTENTIAL: moderate

DESCRIPTION: This poorly graded silty sand is a fair to good foundation when not subject to frost action, having a moderate frost potential and exhibiting fair drainage characteristics.



54 Tuttle Place
Middletown
Connecticut 06457
860 632 1500
FAX 860 632 7879

TEST REFERENCE

LOCATION: Main Street
AREA: 65' west of Wall Street, 7' off the WB curb.

DATE SAMPLED: 3/23/2011
DATE TESTED: 3/24/2011

TEST PIT # 3

DEPTH

CLASSIFICATION
with Field Comments

ENGLISH METRIC



8' 203 mm

Hbt Mix Asphalt (HMA)

5.5' 140 mm

Poorly Graded Silty Sand (SP-SM)

10' 254 mm

Gravel Borrow Fine

Test Pit # 3

Base Poorly Graded Silty Sand (SP-SM)

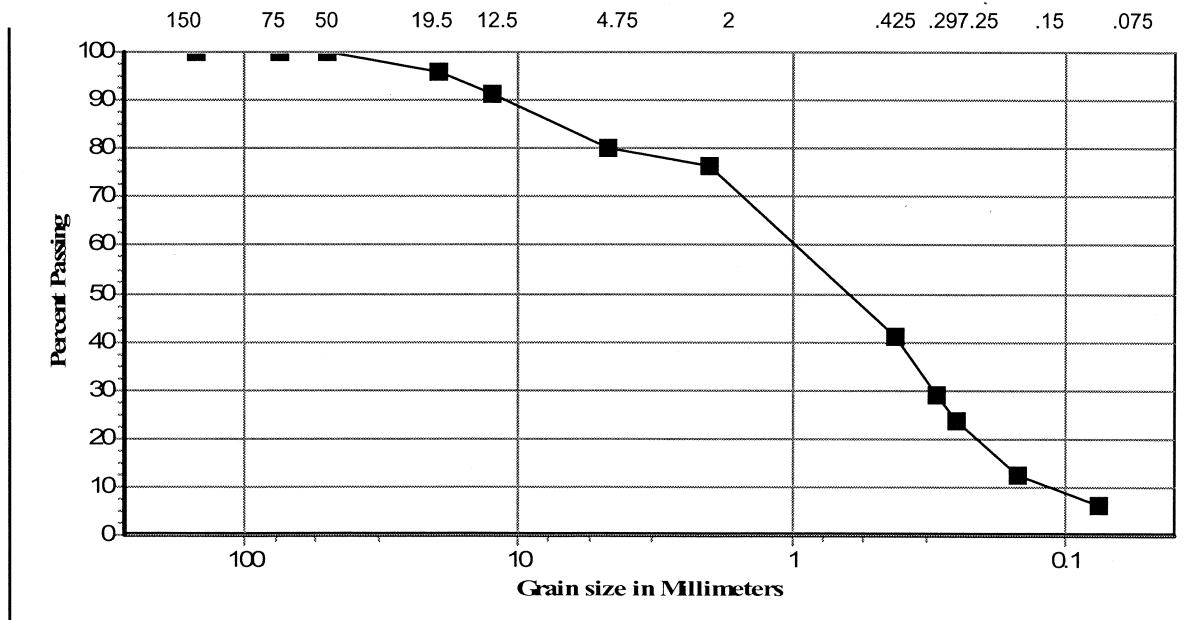
SIEVE SIZE		PERCENT PASSING	MHD Gravel M1.03 SPECIFICATION MHD
150 mm	(6)	100	100
75 mm	(3)	100	
50 mm	(2)	100	
19.5 mm	(3/4)	96	
12.5 mm	(1/2)	91 a	50-85
4.75 mm	(#4)	80 a	40-75
2 mm	(#10)	77	
0.425 mm	(#40)	41	
0.3 mm	(#50)	29 a	8-28
0.25 mm	(#60)	24	
0.15 mm	(#100)	12	
0.075 mm	(#200)	6	0-10

REMARKS: (a) high off specifications; does not conform to specifications

COMMENTS:

Sieve Sizes:

COBBLES	GRAVEL		SAND			CLAY or SILT
	Coarse	Fine	Coarse	Medium	Fine	
	3 1/2"	3/4"	#4	#10	#40	#200



Test Pit # 3

CLASSIFICATIONS:

UNIFIED = SP-SM

AASHTO = A-1-b

% PASSING #200 (Silt or Clay) = 6.2

% PASSING #4 (Sand) = 80.2

LIQUID LIMIT=0

PLASTICITY INDEX =0

GRAIN SIZE ANALYSIS:

D10= 0.12

D30= 0.31

Cu= 8

D60= 1.0

D85= 7

Cc= 0.9

greater than 6 & Well-Graded
between 1 & 3 Sands & Gravels

FROST POTENTIAL: moderate

DESCRIPTION: This poorly graded silty sand is a fair to good foundation when not subject to frost action, having a moderate frost potential and exhibiting fair drainage characteristics.

Test Pit # 3

SubGrade I Gravel Borrow Fine

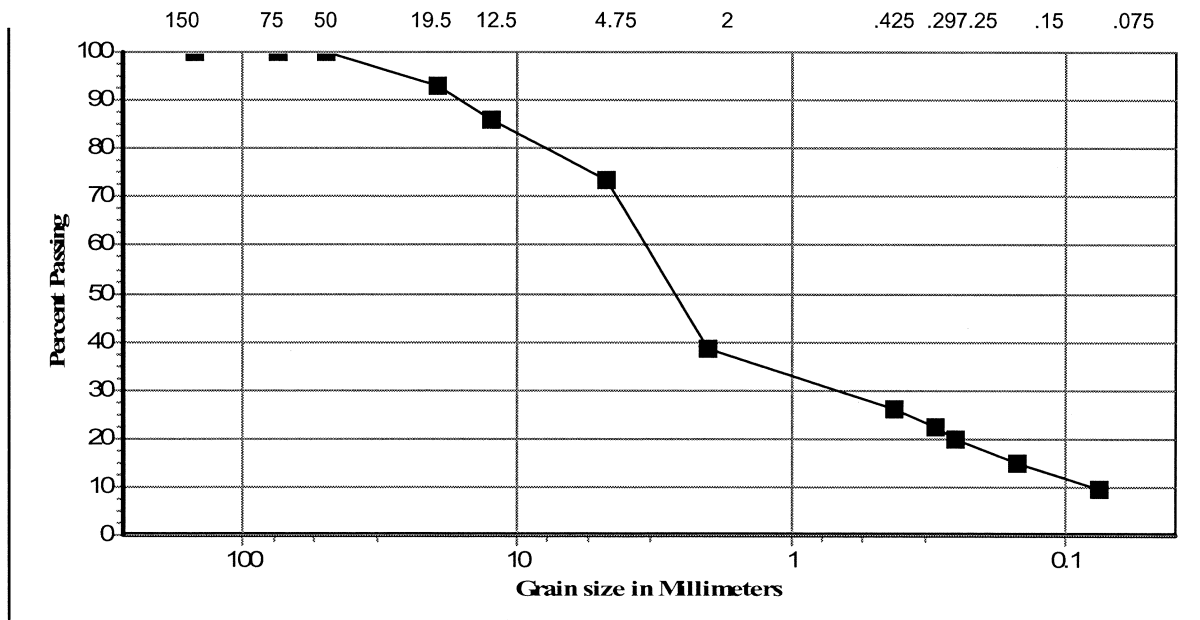
SIEVE SIZE		PERCENT PASSING	MHD Gravel M1.03 SPECIFICATION MHD
150 mm	(6)	100	100
75 mm	(3)	100	
50 mm	(2)	100	
19.5 mm	(3/4)	93	
12.5 mm	(1/2)	86 a	50-85
4.75 mm	(#4)	73	40-75
2 mm	(#10)	38	
0.425 mm	(#40)	26	
0.3 mm	(#50)	22	8-28
0.25 mm	(#60)	20	
0.15 mm	(#100)	15	
0.075 mm	(#200)	10	0-10

REMARKS: (a) high off specifications; does not conform to specifications

COMMENTS:

Sieve Sizes:

COBBLES	GRAVEL		SAND			CLAY or SILT
	Coarse	Fine	Coarse	Medium	Fine	
	3 1/2"	3/4"	#4	#10	#40	#200



Test Pit # 3

CLASSIFICATIONS:

UNIFIED = SW-SM

AASHTO = A-1-a

% PASSING #200 (Silt or Clay) = 9.6

% PASSING #4 (Sand) = 73.2

LIQUID LIMIT=0

PLASTICITY INDEX =0

GRAIN SIZE ANALYSIS:

D10= 0.08

D30= 0.7

Cu= 43

D60= 3.4

D85= 12

Cc= 1.8

greater than 6 & between 1 & 3	Well-Graded Sands & Gravels
-----------------------------------	--------------------------------

FROST POTENTIAL: slight to moderate

DESCRIPTION: This well graded silty sand is a fair to good foundation when not subject to frost action, having a slight to moderate frost potential and exhibiting fair to good drainage characteristics.

COMMONWEALTH OF MASSACHUSETTS

MassDOT

PAVEMENT RESURFACING OVERLAY DESIGN

City/Town	<u>Spencer, MA</u>	Highway System	<u>Principal Arterial</u>
Route No.	<u>Main Street (Route 9)</u>	To Station	<u>High Street</u>
From Station	<u>Maple Street</u>		
No. of Lanes	<u>2</u>		
Date of Overlay Design	<u>June 1, 2011</u>	Pavement Designer	<u>Jonathan S. Gould, PE</u>

EXISTING PAVEMENT STRUCTURE

Depth Inches

<u>6.75</u>	in.	Hot Mix Asphalt
<u> </u>	in.	
<u> </u>	in.	
<u> </u>	in.	
<u>14</u>	in.	Poorly Graded Silty Sand (SP-SM / A-1-b) base
Subgrade = <u>Gravel Borrow Fine (SW-SM / A-1-a)</u>		

PROPOSED MILLING

<u>4.00</u>	Proposed Milling Depth
<u>2.75</u>	Existing HMA Depth after Milling

RECOMMENDED OVERLAY THICKNESS

Total =	<u>4.00</u>	in.	Hot Mix Asphalt Surface and Intermediate Courses		
	<u>2.00</u>	in.	SSC-12.5mm L3	Alt:	SC-B Modified Top
	<u>2.00</u>	in.	SIC-12.5mm L3	Alt:	IC-B Dense Binder

{

w/ PG 76-28 or
Latex Modified
Equivelant

PAVEMENT RESURFACING OVERLAY DESIGN

DATA SHEET 1: PAVEMENT STRUCTURAL DESIGN DATA

Terminal Serviceability Index Nomograph = 2.5

- (a) Current A.D.T. (Date 2011) 14,764
- (b) Future A.D.T. (Date 2031) Growth Rate 0.75% Compounded 17,144
- (c) Mean A.D.T. = $\frac{(a) + (b)}{2}$ 15,954
- (d) Mean A.D.T. In One Direction (c) x $\frac{59.4\%}{WB}$ Directional Distribution 9,477
- (e) A.D.T. Truck Percentage 1.5%
- (f) Mean Truck A.D.T. In One Direction (d) x (e) 142
- (g) Equivalent Daily 18 kip Axle Applications per 1000 trucks and Combinations (See Exhibit 9-2) 880

Highway Class (Exhibit 9-2)	Equivalent 18 kip Axle Applications per 1000 Trucks
Freeways/Expressways	1100
Major Arterial/Minor Arterial (Urban)/Collector (Urban)	880
Minor Arterial (Rural)/Collector (Rural)/Local Roads (City & Town)	660

- (h) Number of 18 kip Axle Loads Per Day in One Direction 125
 $\frac{(f) \times (g)}{1000} (T_{80})$
- (i) 18 kip Load on Design Lane: 1.00 (h) x 1.00 for 2 lanes; 125
(h) x 0.90 for 4 lanes; (h) x 0.80 for 6 or more lanes;
- (j) Subgrade Design Bearing Ratio and Soil Support Value DBR = 30
(**Gravel Borrow Fine (SW-SM / A-1-a)**) SSV = 7.1

*(k) Structural Number (SN) Required Above the Subgrade (Exhibit 9-8) 2.20

*(l) Increase SN by 15% for Design SN 2.53

* These values are developed on Data Sheet #3

PAVEMENT RESURFACING OVERLAY DESIGN

DATA SHEET 2: ACTUAL SN OF EXISTING PAVEMENT STRUCTURE

(a) Soil Support Values of Existing Granular Pavement Elements (Exhibit 9-5)

Penetrated Crushed Stone Macadam	_____
Dense Graded Crushed Stone Base/Subbase	_____
Poorly Graded Silty Sand (SP-SM / A-1-b)	<u>6.2</u>
Subgrade = Gravel Borrow Fine (SW-SM / A-1-a)	<u>7.1</u>

(b) Actual Structural Number (SN) of Each Layer of Existing Pavement

Proposed Milling Depth = <u>4.00</u> inches				
(1) Depth (inches)		(2) Coefficient Exhibit 9-12	(3) RF Exhibit 9-13	(4) Coefficient (1)x(2)x(3)
<u>2.75</u>	Hot Mix Asphalt Surface & Intermediate	<u>0.44</u>	<u>0.92</u>	<u>1.11</u>
<u> </u>		<u> </u>	<u> </u>	<u> </u>
<u> </u>		<u> </u>	<u> </u>	<u> </u>
<u> </u>		<u> </u>	<u> </u>	<u> </u>
<u>14.0</u>	Poorly Graded Silty Sand	<u>0.08</u>	<u>0.92</u>	<u>1.03</u>
Gravel Borrow Fine (SW-SM / A-1-a)				
Total SN = <u>2.14</u>				

(c) Actual Structural Number (SN) Above Each Layer of Existing Pavement

Above Top of:	SN* HMA				SN* Gravel Subbase	Total SN**
Poorly Graded Silty Sand	1.11					1.11
Subgrade	1.11				1.03	2.14

* From Table (b) Above

** Accumulated SN Values from Layers Above

PAVEMENT OVERLAY DESIGN

DATA SHEET 3: DETERMINATION OF OVERLAY THICKNESS

(a) Required Structural Number (SN) Above Each Layer of Existing Pavement (Exhibit 9-8)

	<u>SN</u>	<u>+15%</u>
Above Top of :	_____	_____
Above Top of :	_____	_____
Above Top of : Poorly Graded Silty Sand	<u>2.50</u>	<u>2.88</u>
Above Top of : Gravel Borrow Fine (SW-SM / A-1-a)	<u>2.20</u>	<u>2.53</u>

(b) SN Deficiency to be Corrected with an Overlay

Above Top of:	Required SN*	Actual SN**	SN Difference
Poorly Graded Silty Sand	2.88	1.11	1.76
Subgrade	2.53	2.14	0.39

* From Table (b) Above

** Accumulated SN Values from Layers Above

(c) Thickness of Hot Mix Asphalt Overlay

$$\text{Depth} = \frac{\text{Largest SN Difference}}{0.44} = \frac{\mathbf{1.76}}{0.44} = \mathbf{4.00} \text{ inches}$$

Comments: **Traffic Data Collected between Tuesday, April 12, 2011 and Wednesday, April 13, 2011 by Innovative Data, LLC - 50 Alden Avenue, Belchertown, MA 01007**

COMMONWEALTH OF MASSACHUSETTS

MassDOT

PAVEMENT RESURFACING OVERLAY DESIGN

City/Town	<u>Spencer, MA</u>	Highway System	<u>Principal Arterial</u>
Route No.	<u>Main Street (Route 9)</u>	To Station	<u>High Street</u>
From Station	<u>Maple Street</u>		
No. of Lanes	<u>2</u>		
Date of Overlay Design	<u>June 1, 2011</u>	Pavement Designer	<u>Jonathan S. Gould, PE</u>

EXISTING PAVEMENT STRUCTURE

Depth Inches

6.75 in. Hot Mix Asphalt

 in.

 in.

 in.

14 in. Poorly Graded Silty Sand (SP-SM / A-1-b) base

Subgrade = Gravel Borrow Fine (SW-SM / A-1-a)

PROPOSED MILLING

2.00 Proposed Milling Depth

4.75 Existing HMA Depth after Milling

RECOMMENDED OVERLAY THICKNESS

Total = 2.00 in. Hot Mix Asphalt Surface Course

2.00 in. **SSC-12.5mm L3** Alt: SC-B Modified Top w/ PG 76-28 or
Latex Modified Equivelant

PAVEMENT RESURFACING OVERLAY DESIGN

DATA SHEET 1: PAVEMENT STRUCTURAL DESIGN DATA

Terminal Serviceability Index Nomograph = 2.5

- (a) Current A.D.T. (Date 2011) 14,764
- (b) Future A.D.T. (Date 2031) Growth Rate 0.75% Compounded 17,144
- (c) Mean A.D.T. = $\frac{(a) + (b)}{2}$ 15,954
- (d) Mean A.D.T. In One Direction (c) x $\frac{59.4\%}{WB}$ Directional Distribution 9,477
- (e) A.D.T. Truck Percentage 1.5%
- (f) Mean Truck A.D.T. In One Direction (d) x (e) 142
- (g) Equivalent Daily 18 kip Axle Applications per 1000 trucks and Combinations (See Exhibit 9-2) 880

Highway Class (Exhibit 9-2)	Equivalent 18 kip Axle Applications per 1000 Trucks
Freeways/Expressways	1100
Major Arterial/Minor Arterial (Urban)/Collector (Urban)	880
Minor Arterial (Rural)/Collector (Rural)/Local Roads (City & Town)	660

- (h) Number of 18 kip Axle Loads Per Day in One Direction 125
 $\frac{(f) \times (g)}{1000} (T_{80})$
- (i) 18 kip Load on Design Lane: 1.00 (h) x 1.00 for 2 lanes; 125
(h) x 0.90 for 4 lanes; (h) x 0.80 for 6 or more lanes;
- (j) Subgrade Design Bearing Ratio and Soil Support Value DBR = 30
(**Gravel Borrow Fine (SW-SM / A-1-a)**) SSV = 7.1

* (k) Structural Number (SN) Required Above the Subgrade (Exhibit 9-8) 2.20

* (l) Increase SN by 15% for Design SN 2.53

* These values are developed on Data Sheet #3

PAVEMENT RESURFACING OVERLAY DESIGN

DATA SHEET 2: ACTUAL SN OF EXISTING PAVEMENT STRUCTURE

(a) Soil Support Values of Existing Granular Pavement Elements (Exhibit 9-5)

Penetrated Crushed Stone Macadam	_____
Dense Graded Crushed Stone Base/Subbase	_____
Poorly Graded Silty Sand (SP-SM / A-1-b)	<u>6.2</u>
Subgrade = Gravel Borrow Fine (SW-SM / A-1-a)	<u>7.1</u>

(b) Actual Structural Number (SN) of Each Layer of Existing Pavement

Proposed Milling Depth = <u>2.00</u> inches			
(1) Depth (inches)	(2) Coefficient Exhibit 9-12	(3) RF Exhibit 9-13	(4) Coefficient (1)x(2)x(3)
<u>4.75</u> Hot Mix Asphalt Surface & Intermediate	<u>0.44</u>	<u>0.92</u>	<u>1.92</u>
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
<u>14.0</u> Poorly Graded Silty Sand Gravel Borrow Fine (SW-SM / A-1-a)	<u>0.08</u>	<u>0.92</u>	<u>1.03</u>
Total SN =			<u><u>2.95</u></u>

(c) Actual Structural Number (SN) Above Each Layer of Existing Pavement

Above Top of:	SN* HMA				SN* Gravel Subbase	Total SN**
Poorly Graded Silty Sand	1.92					1.92
Subgrade	1.92				1.03	2.95

* From Table (b) Above

** Accumulated SN Values from Layers Above

PAVEMENT OVERLAY DESIGN

DATA SHEET 3: DETERMINATION OF OVERLAY THICKNESS

(a) Required Structural Number (SN) Above Each Layer of Existing Pavement (Exhibit 9-8)

	<u>SN</u>	<u>+15%</u>
Above Top of :	_____	_____
Above Top of :	_____	_____
Above Top of : Poorly Graded Silty Sand	<u>2.50</u>	<u>2.88</u>
Above Top of : Gravel Borrow Fine (SW-SM / A-1-a)	<u>2.20</u>	<u>2.53</u>

(b) SN Deficiency to be Corrected with an Overlay

Above Top of:	Required SN*	Actual SN**	SN Difference
Poorly Graded Silty Sand	2.88	1.92	0.95
Subgrade	2.53	2.95	-0.42

* From Table (b) Above

** Accumulated SN Values from Layers Above

(c) Thickness of Hot Mix Asphalt Overlay

$$\text{Depth} = \frac{\text{Largest SN Difference}}{0.44} = \frac{\mathbf{0.95}}{0.44} = \mathbf{2.16} \text{ inches}$$

Comments: **Traffic Data Collected between Tuesday, April 12, 2011 and Wednesday, April 13, 2011 by Innovative Data, LLC - 50 Alden Avenue, Belchertown, MA 01007**

COMMONWEALTH OF MASSACHUSETTS

MassDOT

PAVEMENT DESIGN

NEW AND RECONSTRUCTED PAVEMENTS

City/Town	<u>Spencer, MA</u>		
Route No.	<u>Main Street (Route 9)</u>	Highway System	<u>Principal Arterial</u>
From Station	<u>Maple Street</u>	To Station	<u>High Street</u>
No. of Lanes	<u>2</u>		
Date of Pavement Design	<u>June 1, 2011</u>	Pavement Designer	<u>Jonathan S. Gould, PE</u>

RECOMMENDED PAVEMENT STRUCTURE

<u>Surface Course:</u>	<u>2.00</u>	in.	Hot Mix Asphalt	w/ PG 76-28
			SSC-12.5mm L3	SC-B Modified Top or Latex Modified Equivalent
<u>Intermediate Course:</u>	<u>2.00</u>	in.	Hot Mix Asphalt	w/ PG 76-28
			SIC-12.5mm L3	IC-B Dense Binder or Latex Modified Equivalent
<u>Base Course:</u>	<u>3.50</u>	in.	Hot Mix Asphalt	
			SBC-25.0mm L3	BC-A Black Base
<u>Subbase</u>	<u>4</u>	in.	Section 402 Dense Graded Crushed Stone for Subbase	
			Dense Graded Crushed Stone	
<u>Subbase</u>	<u>8</u>	in.	Section 401 Gravel Subbase	
			Gravel Borrow	
<u>Special Borrow:</u>		in.		
			Subgrade =	<u>Gravel Borrow Fine (SW-SM / A-1-a)</u>

NEW AND RECONSTRUCTED PAVEMENTS

DATA SHEET 1: PAVEMENT STRUCTURAL DESIGN DATA

Terminal Serviceability Index Nomograph = 2.5

- (a) Current A.D.T. (Date 2011) 14,764
- (b) Future A.D.T. (Date 2031) 0.75% /Year Compounded 17,144
- (c) Mean A.D.T. = $\frac{(a) + (b)}{2}$ 15,954
- (d) Mean A.D.T. In One Direction (c) x 59.4% Directional Distribution WB 9,477
- (e) A.D.T. Truck Percentage 1.5%
- (f) Mean Truck A.D.T. In One Direction (d) x (e) 142
- (g) Equivalent Daily 18 kip Axle Applications per 1000 trucks and Combinations (See Exhibit 9-2) 880

Highway Class	Equivalent 18 kip Axle Applications per 1000 Trucks
Freeways/Expressways	1100
Major Arterial/Minor Arterial (Urban)/Collector (Urban)	880
Minor Arterial (Rural)/Collector (Rural)/Local Roads (City & Town)	660

- (h) Number of 18 kip Axle Loads Per Day in One Direction 125
- $\frac{(f) \times (g)}{1000} (T_{80})$

Comments: Traffic Data Collected between Tuesday, April 12, 2011 and Wednesday, April 13, 2011
by Innovative Data, LLC - 50 Alden Avenue, Belchertown, MA 01007

NEW AND RECONSTRUCTED PAVEMENTS

DATA SHEET 2: DETERMINATION OF STRUCTURAL NUMBER (SN)

Design Lane Equivalent Daily 18 kip Applications (T80)

For 2-Lane Undivided Highway

$$\text{Design Lane T80} = 1.00 \times \text{Total T80}^* = 1.00 \times \underline{\underline{125}} \quad \underline{\underline{125}}$$

For 4 (Total Lanes) Lane Divided Highway

$$\text{Design Lane T80} = 0.90 \times \text{Total T80}^* = 0.90 \times \underline{\hspace{1cm}} \quad \underline{\hspace{1cm}}$$

Design 6 or More (Total Lanes) Divided Highway

$$\text{Design Lane T80} = 0.80 \times \text{Total T80}^* = 0.80 \times \underline{\hspace{1cm}} \quad \underline{\hspace{1cm}}$$

Design DBR and SSV (Exhibit 9-5)

Subbase	<u>Dense Graded Crushed Stone</u>	DBR = <u>45</u>	SSV = <u>8.0</u>
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Subbase	<u>Gravel Borrow</u>	DBR = <u>40</u>	SSV = <u>7.8</u>
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Subgrade	<u>Gravel Borrow Fine (SW-SM / A-1-a)</u>	DBR = <u>30</u>	SSV = <u>7.1</u>
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Design Structural Number (SN)

Apply Design SSV and Design Lane T80 from above to Design Nomograph (Exhibit 9-8)

	Material	From Exhibit 9-8	+ 15%
Above Subbase	<u>Dense Graded Crushed Stone</u>	<u>1.92</u>	<u>2.21</u>
Above Subbase	<u>Gravel Borrow</u>	<u>2.00</u>	<u>2.30</u>
Above Subgrade	<u>Gravel Borrow Fine (SW-SM / A-1-a)</u>	<u>2.20</u>	<u>2.53</u>

* From Line (h) of Data Sheet 1.

NEW AND RECONSTRUCTED PAVEMENTS

DATA SHEET 3: DETERMINATION OF STRUCTURAL NUMBER

$$SN = D_1a_1 + D_2a_2 + D_3a_3$$

			Thickness inches	Layer Coefficient		
<u>Surface</u>	Mix Designations (Exhibit 9-9)				(Exhibit 9-13)	
	Material: SSC-12.5mm L3	$D_1a_1 =$	2.00	0.44	=	0.88
	SC-B Modified Top					
<u>Intermediate Course</u>						
	Material: SIC-12.5mm L3	$D_1a_1 =$	2.00	0.44	=	0.88
	IC-B Dense Binder					
<u>Base Course</u>						
	Material: SBC-25.0mm L3	$D_2a_2 =$	3.50	0.34	=	1.19
	BC-A Black Base					
		Total SN Above Subbase				2.95
		Minimum Required Above Subbase (Data Sheet 2)			>	2.30
<u>Subbase (Foundation)</u>			Inches			
	Material: Dense Graded Crushed Stone	$D_3a_3 =$	4	0.14	=	0.56
	Material: Gravel Borrow	$D_3a_3 =$	8	0.11	=	0.88
		Total SN Above Subgrade				4.39
		Minimum Required Above Subgrade (Data Sheet 2)			>	2.53

Comments: In areas of widening or realignment, plan to RECONSTRUCT the existing pavement and poorly graded silty sand subbase. Prepare the existing subgrade prior to placing 8" of gravel borrow subbase and 4" of dense graded crushed stone base. Compact to proper lines and grades prior to placing 3.5" of SBC-25.0mm L3 base course. An additional 2.0" of SIC-12.5mm L3 intermediate course and 2.0" of SSC-12.5mm L3 surface course with PG 76-28 liquid or latex modified equivalent should then be placed.

As an alternative, the following Superpave designated mixes can be utilized:
 SC-B Modified Top surface course with PG 76-28 or latex modified equivalent, IC-B Dense Binder intermediate course with PG 76-28 or latex modified equivalent, and BC-A Black Base base course.

Vanasse Hangen Brustlin, Inc.

Project:	Main Street (Rt 9)	Project #:	11537.00
Location:	Spencer, MA	Sheet:	1 of 2
Calculated by:	GJR	Date:	5/3/2011
Checked by:	MJC	Date:	5/3/2011
Title:	Design Designation Data-Main St between Maple St & High St		

Average Daily Traffic (ADT) = 7,271 + 7,493 = 14,764 vpd
ATRs from Tues 4-12-11 & Wed 4-13-11

$$\text{Seasonally Adjusted ADT} = 14,764 * 0.00\% = 14,764 \text{ vpd}$$

K Factor = $\frac{384 + 562}{14,764} = 0.06$

$$D = \frac{562}{384 + 562} = 59.4\% \text{ WB}$$
$$\text{Peak Hour \% Trucks} = \frac{14 + 11}{1,488} = 1.7\%$$
$$\text{Daily \% Trucks} = \frac{88 + 135}{14,764} = 1.5\%$$

Design Year ADT =	Background:	14,764	* (1+.0075)^10	=	15,909
	Project:				
	Other Specific Projects:				
			Total:		15,909 vpd

$$\text{DHV} = 15,909 * 0.06 = 1,019 \text{ vph}$$
$$\text{DDHV} = 1,019 * 59.4\% = 606 \text{ vph}$$



Project:	Main Street (Rt 9)	Project #:	11537.00
Location:	Southborough, MA	Sheet:	2 of 2
Calculated by:	GJR	Date:	5/3/2011
Checked by:	MJC	Date:	5/3/2011
Title:	Design Designation Data - Pleasant Street (Route 31)		

$$2009 \text{ Average Daily Traffic (ADT)} = 2,886 + 2,771 = \boxed{5,657 \text{ vpd}} \\ \text{Wed 4-13-11}$$

$$\text{Seasonally Adjusted ADT} = 5,657 * 0.00\% = \boxed{5,657 \text{ vpd}}$$

$$\text{K Factor} = \frac{307 + 245}{5,657} = \boxed{0.10} \\ 7:30 \text{ AM}$$

$$D = \frac{307}{307 + 245} = \boxed{55.6\% \text{ NB}}$$

$$\text{Peak Hour \% Trucks} = \boxed{1.3\%} \\ (\text{From TMC Counts})$$

$$\text{Daily \% Trucks} = \boxed{1.3\%} \\ (\text{Assumed from TMC Counts})$$

$$2021 \text{ Design Year ADT} = \begin{array}{l} \text{Background: } 5,657 \\ \text{Project:} \\ \text{Other Specific Projects:} \end{array} * (1+0.0075)^{10} = 6,096$$

$$\text{Total: } \boxed{6,096 \text{ vpd}}$$

$$\text{DHV} = 6,096 * 0.10 = \boxed{595 \text{ vph}}$$

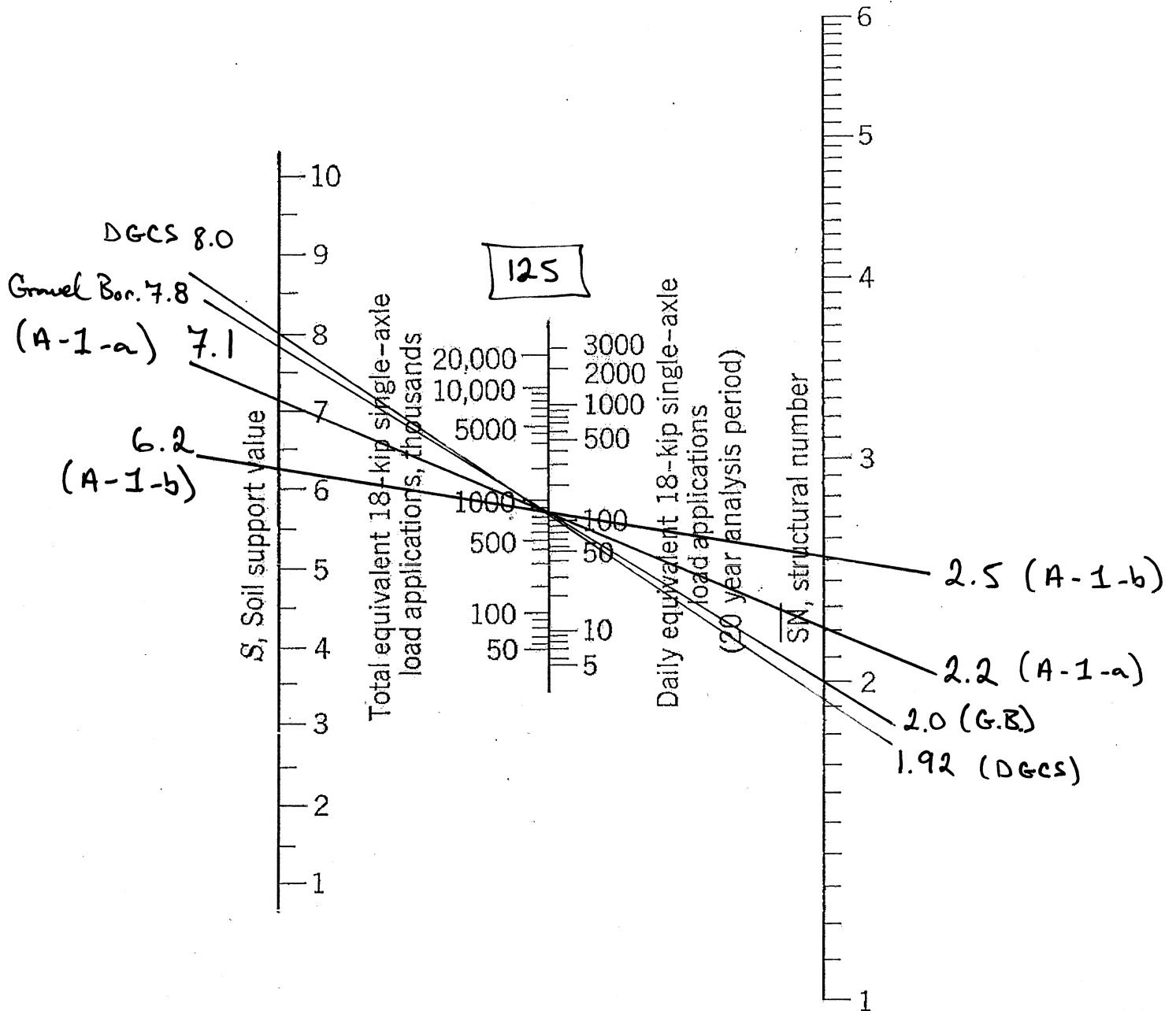
$$\text{DDHV} = 595 * 55.6\% = \boxed{331 \text{ vph}}$$

MAIN STREET - SPENCER, MA
(High St. to Maple St.)

2006 EDITION



Exhibit 9-8
Structural Number Nomograph (For Flexible Pavements P=2.5)



Note: The right side of the vertical line in the center provides the daily equivalent 18-kip single-axle load. It is only good for a 20-year analysis period. The left side provides the total load application and it can be used for any design analysis period.

Source: Interim Guide for Pavement Structures. AASHTO. 1972.

MassDOT Pavement Design Checklist

I. Project Identification

City/Town :	Spencer, MA	Project Number :	606207
Street/Rte. No. :	Main Street (Route 9)	Functional Class :	Principal Arterial
From Station :	100+050	To Station :	113+23
From (Landmark):	Maple Street	To (Landmark) :	High Street
Date :	6/1/2011	Design Engineer :	Jonathan S. Gould, PE

II. Traffic Data

Current ADT (year) :	14,764 (2011)	Future ADT (Year)* :	17,144 (2031)
T (ADT) :	1.5%	T (PEAK HR.) :	1.7%
No. of Lanes :	2	Divided/Undivided :	Undivided

III. Existing Pavement Information

Year Initially Constructed : n/a **Overlaid :** n/a

Existing Pavement Structure :

<u>Layer</u>	<u>Depth</u>	<u>Type</u>
Surface :	6.75"	Hot Mix Asphalt
Intermediate :		
Base :		
Sub-base-1 :	14.0"	Poorly Graded Silty Sand (SP-SM / A-1-b)
Sub-base-2:		
Subgrade :		Gravel Borrow Fine (SW-SM / A-1-a)

IV. Document Existing Pavement Distress

Type	Extent	Severity			Depth
	(percentages)	High	Medium	Low	Inches
Block Cracking					
Other Cracking (transverse, longitudinal, reflective)	5 – 50%			☒	
Lane/Shoulder Drop-off					
Potholes					
Rutting (wheelpaths)	5 – 50%	☒			
Alligator Cracking					
Other – Surface wear/raveling	Localized			☒	
Other – Distortions					

Notes:

1. If existing pavement is PCC, provide a separate description of pavement
2. Provide photographs as needed to demonstrate pavement distress

* Minimum 20 yr. protection

V. Proposed Corrective Work to Existing Pavement (if any)

Leveling Course	Subdrainage Pipes
Crackfilling*	Deep Patching/Pothole Filling
Prime	Other -
<input checked="" type="checkbox"/> Cold Planning	Other -
Heater/Scarifier	Other – Shoulder Grading

Discussion (if needed):

Any special site conditions which may limit the practical choices -

VI. Proposed Scope of Work

New Pavement	<input checked="" type="checkbox"/> Pavement Overlay
Reconstructed Pavement	With widening
Recycling	Without widening
Surface (in place)	<input checked="" type="checkbox"/> With corrective work to existing pavement
Cold-Mix	Without corrective work to existing pavement
Hot-Mix	

Discussion (if needed):

Pavement Rutting & Shoving is the primary distress within the existing pavement structure. This is a function of the existing HMA aggregate and liquid than that of the existing base materials. The other surface related pavement distress is Transverse & Longitudinal cracking at the limits of utility trenches.

Pavement Rut depths were measured and averaged 1.25" to about 2.5" in depth with isolated areas greater than 2.5". The worst of the rutting is located on the downhill section of Main Street (WB) at the intersection with Pleasant Street attributed to slow moving, braking traffic at the signalized intersection.

Due to the heavy rutting, a 2" mill and overlay would not remove very much of the unstable HMA in the wheel paths and is not recommended for Main Street. It is recommended that the depth of milling be 4" and paved in two lifts of Superpave 12.5mm L3 material using the 455. Superpave QA Specification and Latex Modified Asphalt in both HMA lifts.

A 2" mill and overlay is recommended using Superpave 12.5mm L3 material using the 455. Superpave QA Specification and Latex Modified Asphalt on side streets/commercial driveways and 10' min. overlap at project limits.

VII. Briefly discuss reasons for proposed work, including estimated costs and any special site conditions which may limit the practical choices.

Discussion (if needed):

* Only done under certain circumstance and with the approval of PDE

Horizontal Alignment Reports

Vanasse Hangen Brustlin, Inc.

2 Washington Square

Suite #219

Worcester, Massachusetts 01604

Alignment Curve Report

Client: Town of Spencer

Project Name:

W:\11537.00\cad\te\plan\set\XREFS\606207_HD(PR).dwg

Project Description:

Report Date: 11/22/2013 10:58:44 AM

Prepared by: Amanda
Bazinet

Alignment: Main Street

Description:

<u>Tangent Data</u>			
Length:	359.16	Course:	N 74° 49' 29.9121" E

<u>Circular Curve Data</u>			
Delta:	08° 28' 00.7092"	Type:	RIGHT
Radius:	700.00		
Length:	103.44	Tangent:	51.82
Mid-Ord:	1.91	External:	1.92
Chord:	103.35	Course:	N 79° 03' 30.2667" E

<u>Circular Curve Data</u>			
Delta:	09° 29' 13.3985"	Type:	RIGHT
Radius:	1000.00		
Length:	165.58	Tangent:	82.98
Mid-Ord:	3.43	External:	3.44
Chord:	165.39	Course:	N 88° 02' 07.3205" E

<u>Tangent Data</u>			
Length:	238.26	Course:	S 87° 13' 15.9802" E

<u>Circular Curve Data</u>			
Delta:	48° 19' 00.2781"	Type:	LEFT
Radius:	315.00		
Length:	265.64	Tangent:	141.29
Mid-Ord:	27.59	External:	30.24
Chord:	257.83	Course:	N 68° 37' 13.8807" E

<u>Tangent Data</u>			
Length:	217.89	Course:	N 44° 27' 43.7417" E

Alignment: Pleasant Street

Description:

<u>Tangent Data</u>			
Length:	86.94	Course:	S 08° 10' 02.7401" E

<u>Circular Curve Data</u>			
Delta:	20° 03' 39.3404"	Type:	RIGHT
Radius:	410.00		
Length:	143.55	Tangent:	72.52
Mid-Ord:	6.27	External:	6.36
Chord:	142.82	Course:	S 01° 51' 46.9300" W

<u>Tangent Data</u>			
Length:	106.51	Course:	S 11° 53' 36.6002" W

<u>Circular Curve Data</u>			
Delta:	19° 17' 22.5307"	Type:	LEFT
Radius:	335.00		
Length:	112.78	Tangent:	56.93
Mid-Ord:	4.74	External:	4.80
Chord:	112.25	Course:	S 02° 14' 55.3349" W
